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toes thickly coated with feathers, which can be spread out, and by means of the long and straight claws—which may be compared with snowshoes—are enabled to run easily over the snow, the usefulness and the necessity of the lengthening of the nails is self-evident. In the genus Tetrao (=Urogallus+Lyrurus+Bonasa) the lateral horny fringes of the toes render the same excellent service, and may fitly be regarded as a kind of snowshoes. *During the summer this whole outfit becomes superfluous*, which may be the main cause of the periodical shedding." It may in this connection be mentioned, that the horny fringes in Tetraones, and the thick feathering of the toes in Lagopodes also moult during the summer, at which time the toes of the latter are almost wholly denuded of feathers.

ON THE CONSTITUTION OF SOME APPENDAGES OF THE MOLLUSCA.

BY W. H. DALL.

IT is comparatively recently that the organic chemists have devoted any time to the investigation of the constitution of invertebrate organs or appendages, especially among brachiopods and mollusks. In the rare cases in which this has been done the observations in many cases were overlooked by the biologists most interested, and the occurrence of phosphate of lime in the shells of certain brachiopods is almost a singular instance where the statement of such a fact has penetrated all the manuals and text-books.

The teeth and radula of mollusks, an apparatus extremely characteristic of several classes of that sub-kingdom, and upon which classification has been largely based for at least thirty years, are commonly referred to in the text-books as "silicious," or "horny." The jaw, which is developed in nearly all of them, is referred to in the latest general work on the Mollusks (Encyclopædia Britannica, Art. *Mollusca*, p. 641), by Professor E. Ray Lankester in the following terms: "We find almost universally present in the Glossophora a pair of horny jaws (usually calcified) developed as cuticular productions upon the epidermis of the lips." The same author refers to the radula as "a chitinous band beset with minute teeth," "a horny cuticular product," and a "horny radula or lingual ribbon."

In various papers on the Mollusca, in which the dentition has been discussed, I have (and doubtless others have) called attention incidentally to the chitinous nature of the teeth of mollusks, and also to the fact that those groups, believed to be of very ancient lineage, and to have been less altered from their early status than many others, have the teeth composed of chitinous parts cemented together and to the radula with a horny cement which dissolves in boiling liquor potassæ. This is the case in the Docoglossa and Chitons. In these the base of the radula and the above mentioned cement are probably of a truly horny constitution. In the Pulmonata the radula and teeth are of a higher character, and apparently purely chitinous, though in but few of the groups has the jaw attained this constitution.

It is well known that in some of the most highly organized gastropods, such as Conus, the teeth are specialized, few in number, in some cases tubular, barbed and furnished with a true poison gland and duct, by which a very severe injury can be inflicted on an assailant, even a conchologist. The secretion of sulphuric acid by the genus Dolium is doubtless connected with its habit of boring the calcareous shells of its molluscan prey by means of its teeth and radular apparatus, and the secretion of such strength that it must form a very efficient solvent, and greatly hasten the desired result. It may also be used as a poison against a soft-bodied adversary, but this is not definitely known. The statement of Professor Lankester that the jaws of mollusks are " usually calcified," is entirely erroneous. That some of them may have a calcareous coating or reinforcement is possible, though no such case is known to me, but at any rate it must be of very exceptional occurrence.

Dr. O. Loew, well known for his chemical investigations, when connected with the Wheeler survey was kind enough to undertake, at my suggestion, some qualitative analyses of organic products, for which I furnished the materials, about 1875.

To determine the nature of the molluscan jaw a number of the beaks of cephalopods (probably Loligo) were examined. The black horny matter yielded very slowly to prolonged boiling in saturated liquor potassæ, but after this result a pellucid portion remained retaining the exact form of the jaw and about one-third of the total volume. This was boiled in strong acids and alkalies for a long time without yielding or being visibly affected.

Dr. Loew observed that chitine when treated with dilute sulphuric acid gives a reaction of sugar, the present substance gave no such reaction, and is therefore different from chitine and probably undescribed. It is probably closely allied to chitine but may contain a relatively larger amount of nitrogen.

Having collected a large quantity of the epidermis of the common brown mussel (*Modiola modiolus* L.) it was found to consist of purely horny matter, and dissolved with great ease in liquor potassæ. The conchioline which cements the layers of the shell is probably of a more refractory nature, but difficult to isolate without much labor except in very small quantities. If the fresh mussels be put in a box in a hot place the epidermis spontaneously scales off, and may be collected without trouble.

The horny shell of a gastropod which is distinguished by not becoming calcified (*Velutina coriacea* Pallas) was found to consist almost wholly of horny matter, with a trace of phosphate and a little carbonate of lime.

A large number of the shells of a brachiopod (*Rhynchonella psittacea* Ch.) were examined, and to our surprise yielded only a bare trace of phosphate of lime, 92 to 94 per cent of carbonate of lime, and the remainder consisted of horny matter. This raises a question as to the uniformity of the presence in other brachiopods (Lingula, Discina) of the large proportion of phosphate of lime, which has been detected in several analyses.

I have brought up this subject not so much for the value of the contribution now made to it (which is small), but rather to stimulate some of our chemical friends to work in a direction far more promising for science than some which of late have been more fashionable, and to call attention to our extreme ignorance of a great class of facts which, so to speak, lie daily before us demanding a solution.

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THE THEORY OF SEX AND SEXUAL GENESIS.

BY C. M. HOLLINGSWORTH.

(*Continued from page 677, July number.*)

THE view taken by Simpson seems to me altogether a just one, with regard to "the origin of those varieties of double hermaphrodites in which there is an actual coëxistence upon one or upon both sides of the body, or, in other words, in the same